

## The amathiiform Ctenostomata (phylum Bryozoa) of New Zealand—including four new species, two of them of probable alien origin

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### Abstract

The status of the vesiculariid ctenostome genus *Amathia* in New Zealand has been evaluated on the basis of all known material, including historic specimens in museums and those newly collected during formal surveillance of ports, harbours and vessels for possible alien species. Eight species are recognised, four of them new to science. *Amathia gracei* n. sp. and *Amathia zealandica* n. sp. are the only apparently endemic species. *Amathia chimonidesi* n. sp. appears to be a previously unrecognised alien species and is known only from shipping harbours and/or yacht marinas and some nearby beaches. *Amathia similis* n. sp. has been known in the Auckland area since the 1960s but was confused with *A. distans* Busk. *Amathia bicornis* (Tenison-Woods), *A. biseriata* Krauss, *A. lamourouxi* Chimonides and *A. wilsoni* Kirkpatrick are Australasian species that occur naturally on both sides of the Tasman Sea. Of this latter group, *A. bicornis* was discovered only at a single locality on the southwest coast of North Island in 1983 on a fucoid seaweed and it may be relatively recently self-introduced. A specimen of *A. lendigera* (Linnaeus) in the Museum of New Zealand, purportedly from Napier, is considered to be based on a misunderstanding or a labelling error and does not represent a failed alien introduction. The *Amathia*-like vesiculariid *Bowerbankia citrina* (Hincks) sensu lato is newly recorded for New Zealand. Keys are provided to the amathiiform (i.e. *Amathia* and *Amathia*-like) Ctenostomata of New Zealand and to the worldwide species of *Amathia* and *Bowerbankia* with zooid clusters spiralled on stoloniform axes.

**Key words:** Bryozoa, Ctenostomata, *Amathia*, *Bowerbankia citrina*, new species, introduced species

### Introduction

*Amathia* Lamouroux, 1812 is a well-known genus of Vesiculariidae that has been reported from all continents except Antarctica. All species have branching colonies, dendroid, bushy or repent, that are made up of stolon segments, separated by septa at nodes, which bear clusters of autozooids. The distinctive feature of the genus, reflected in a later junior synonym (*Serialaria* Lamarck, 1816), is that the autozooids are seriated in the clusters, occurring in actual or slightly offset pairs that are connate with adjacent autozooids for a considerable part of their height, the connate wall being slightly (or considerably) more cuticularised than the extensible distal part. The genus is known from the latest Mesozoic (Maastrichtian), based on a bioimmured fossil, *Amathia immurata* Voigt, 1972, which preserves the imprint of spiralled autozooid clusters about a stoloniform axis. *Amathia* is nested within the confamilial genus *Bowerbankia* Farre, 1837 in gene trees (Waeschenbach *et al.* 2012), with an unnamed *Amathia* species sister to *Bowerbankia citrina* (Hincks, 1877) from Wales. After accounting for synonyms (Prenant & Bobin 1956; d'Hondt 1983; Chimonides 1987; Souto *et al.* 2010), there are at least 31 valid, previously described *Amathia* species, 16 of which exhibit some degree of spirality of the autozooid clusters on the stolon segments and the balance have the autozooids in more or less straight series (Table 1). Two species of *Bowerbankia*—*B. citrina* and *B. pustulosa* (Ellis & Solander, 1786)—also have a somewhat spiral disposition of autozooidal clusters and hence appear ‘amathiiform,’ but these zooids are not connate nor are the lateral walls differentially cuticularised.

**TABLE 1.** The valid living species of *Amathia* Lamouroux, 1812 (including new species described herein).

Species	Disposition of zooid clusters on stolon	Provenance of labelled holotype and/or as stated in original description, or of neotype* or lectotype† if revised
<i>A. acervata</i> Lamouroux, 1824	spiral	Japan Sea <sup>1</sup>
<i>A. aegyptiana</i> d'Hondt, 1983	spiral	Suez Canal, Egypt <sup>1</sup>
<i>A. alternata</i> Lamouroux, 1816	straight	*off Cape Fear, North Carolina, USA <sup>2</sup>
<i>A. bicornis</i> Tenison-Woods, 1880	spiral	SE Australia (Tasmania?) <sup>1</sup>
<i>A. biseriata</i> Krauss, 1837	straight	*Port Phillip, Victoria, Australia <sup>2</sup>
<i>A. brasiliensis</i> Busk, 1886	spiral	off Bahia, Brazil <sup>1</sup>
<i>A. brongniartii</i> Kirkpatrick, 1888	straight	*Port Phillip, Victoria, Australia <sup>2</sup>
<i>A. chimonides</i> n. sp.	spiral	Auckland Harbour, New Zealand <sup>1</sup>
<i>A. connexa</i> Busk, 1886	spiral	off Cape York, Queensland, Australia <sup>1</sup>
<i>A. convoluta</i> (Lamarck, 1816)	spiral	Australia <sup>1</sup>
<i>A. crispa</i> (Lamarck, 1816)	spiral	Bass Strait, Australia <sup>3</sup>
<i>A. delicatula</i> Souto <i>et al.</i> , 2010	straight	Punta de la Guardia, Mallorca, Spain <sup>1,4</sup>
<i>A. dichotoma</i> (Verrill, 1873)	spiral	Great Egg Harbor, New Jersey, USA <sup>1</sup>
<i>A. distans</i> Busk, 1886	spiral	off Bahia, Brazil <sup>1</sup>
<i>A. gracei</i> n. sp.	spiral	ENE of East Cape, New Zealand <sup>1</sup>
<i>A. guernseii</i> Chimonides, 1987	straight	Saints Bay, Guernsey <sup>1</sup>
<i>A. intermedis</i> Chimonides, 1987	straight	Hastings, England, UK <sup>1</sup>
<i>A. lamourouxi</i> Chimonides, 1987	straight	*Port Phillip, Victoria, Australia <sup>1</sup>
<i>A. lendigera</i> (Linnaeus, 1758)	straight	*Chichester Harbour, England, UK <sup>1</sup>
<i>A. minoricensis</i> Souto <i>et al.</i> , 2010	spiral	Canal de Menorca, Balearic Isles, Spain <sup>1,4</sup>
<i>A. obliqua</i> MacGillivray, 1895	straight	Port Phillip Heads, Victoria, Australia <sup>1</sup>
<i>A. pinnata</i> Kirkpatrick, 1888	straight	*Port Phillip, Victoria, Australia <sup>2</sup>
<i>A. plumosa</i> MacGillivray, 1890	straight	Port Phillip Heads, Victoria, Australia <sup>1</sup>
<i>A. populea</i> Busk in d'Hondt, 1983	straight	†Natal, South Africa <sup>2</sup>
<i>A. pruvoti</i> Calvet, 1911	spiral	Mediterranean <sup>2</sup>
<i>A. semiconvoluta</i> Lamouroux, 1824	spiral	†Mediterranean <sup>1,4</sup>
<i>A. semispiralis</i> (Kirchenpauer, 1869)	spiral	Samoa <sup>1</sup>
<i>A. similis</i> n. sp.	spiral	Opua, Bay of Islands, New Zealand <sup>1</sup>
<i>A. tortuosa</i> Tenison-Woods, 1880	spiral	Port Jackson, NSW, Australia <sup>1</sup>
<i>A. tricornis</i> Busk in Chimonides, 1983	straight	Australia <sup>1</sup>
<i>A. vermetiformis</i> Harmer, 1926	spiral	E of Salawati Is., West Papua, Indonesia <sup>1</sup>
<i>A. vidovici</i> (Heller, 1867)	spiral	Capocesto (Primošten), Croatia <sup>1</sup>
<i>A. wilsoni</i> Kirkpatrick, 1888	straight	Port Phillip, Victoria, Australia <sup>1</sup>
<i>A. woodsii</i> Goldstein, 1879	straight	*Port Jackson, NSW, Australia <sup>1</sup>
<i>A. zealandica</i> n. sp.	straight	NE of Spirits Bay, New Zealand <sup>1</sup>

1—Original description; 2—Chimonides (1987); 3—d'Hondt (1979); 4—Souto *et al.* (2010)

Hutton (1873) was the first to describe a species of *Amathia* from New Zealand, which he mistakenly ascribed to the cheilostome genus *Beania* Johnston, 1840. He evidently included a sample of the species in a collection of

bryozoans that he subsequently sent to Eliza C. Jelly in the U.K., who noted in her compendious *Synonymic Catalogue* (Jelly 1889) that *Beania swainsoni* Hutton, 1873 is a species of *Amathia*. Hutton (1891, 1904) and Hamilton (1898) then used the combination *Amathia swainsoni* (Hutton, 1891) in lists of Bryozoa from New Zealand. There were no further published records of the genus in New Zealand until Macken (1956) reported *Amathia wilsoni* Kirkpatrick, 1888 from Wellington, along with the first (and only) record of an alien introduction, in Napier, of *Amathia lendigera* (Linnaeus, 1758), a species known only from Europe. In the same work she synonymised *A. swainsoni* with *Amathia biseriata* Krauss, 1837, otherwise known only from southern Australia.

Eight years later, Harger (1964) reported *Amathia distans* Busk, 1886 as a fouling species in Waitemata Harbour, Auckland. This record was noted by Gordon (1967), who observed the same putative species epizoic on the ctenostome *Zoobotryon verticillatum* (Delle Chiaje, 1822) (as *Z. pellucidum* [sic] Ehrenberg, 1829). Morton & Miller (1968, fig. 152) illustrated the species reported by Harger but referred to it in their text (p. 411) as *A. biseriata*. This is also the form from Auckland illustrated by Gordon & Mawatari (1992) as *A. distans* in their atlas of marine-fouling Bryozoa of New Zealand ports and harbours. Evidence is presented in this paper that this species is not only not *A. distans*, but represents a previously unrecognised undescribed species that is almost certainly alien in New Zealand.

Gordon (1986) added to the known distribution of *A. wilsoni* in New Zealand. Chimonides (1987) confirmed the presence of historical material of *A. wilsoni* and *A. biseriata* from New Zealand based on specimens in the Natural History Museum, London (NHMUK), and added *Amathia lamourouxi* Chimonides, 1987 (*A. cornuta* auctt.), also based on material in NHMUK. The most recent New Zealand Bryozoa checklist (Gordon *et al.* 2009) has five species of *Amathia*, including, in addition to the above, *Amathia bicornis* (Tenison-Woods, 1877) (as *A. acervata* Lamouroux, 1824, based on a synonymous error in d'Hondt 1983).

The purpose of this paper is to assess the status of all of these species in New Zealand in relation to specimens held in New Zealand museums, the National Institute of Water & Atmospheric Research (NIWA) invertebrate collection, and NHMUK, as well as recent new material collected in the course of formal surveillance of New Zealand ports and harbours since 2005. Marine life collected during this surveillance (of vessels, structures, and the seabed in the vicinity) is housed at NIWA as part of the Marine Invasives Taxonomic service (MITS) (see Gordon *et al.* 2008), now funded by the Ministry for Primary Industries. The surveys have turned up specimens of *Amathia* (and other ctenostomes) that either do not conform to the known species in New Zealand or exhibit morphological characters that suggest they are new to science. One *Amathia*-like species collected live in Porirua Harbour represents the first record of *Bowerbankia citrina* sensu lato in New Zealand and the opportunity is taken here formally to record the presence of this taxon also.

## Material and methods

The species studied here were obtained from field collecting by the first author and colleagues or were already lodged in existing museum collections. Specimens that were collected in a partially dried state (beach-cast material), or museum material that had been mounted dry on card, were in some instances reconstituted using aqueous trisodium phosphate and transferred to 70% ethanol. Morphological features were examined under a binocular microscope and measurements made on preserved material using an eyepiece graticule. The new species described here are lodged in the NIWA Invertebrate Collection (NIC) at the National Institute of Water & Atmospheric Research, Wellington.

## Systematic account

### Order Ctenostomata Busk, 1852

#### Family Vesiculariidae Johnston, 1838

#### Genus *Amathia* Lamouroux, 1812

*Amathia gracei* n. sp.

(Figs 1–3, Table 2)

**Material examined.** Holotype: NIWA 84924, from R.V. *Tangaroa* cruise TAN1108, Stn 239, 37.595° S, 178.865° E, ENE of East Cape, North Island, 56–58 m, 1 June 2011. No paratypes.

**Etymology.** Honorific for Dr Roger V. Grace, Leigh, well-known New Zealand research diver and environmentalist.

**Description.** Colony erect, bushy and densely branching, to 70 mm high, with a stout tuft of anchoring rhizoids proximally, brown. Stolon segments gently sinuous rather than straight, mostly 2.7 mm long, each terminating at a regular dichotomy, the angle between the two branches 30–45°. At each dichotomy, one daughter stolon segment tends to continue in line with the parent and is of the same width (diameter), with the opposing daughter stolon segment frequently of smaller width. Mean stolon width 0.23 mm. Autozooid clusters disposed in an anticlockwise spiral on each stolon segment, comprising c. 16–23 ‘pairs’ per cluster, each cluster describing a complete 360° circuit of the stolon segment from its commencement to its completion; each cluster has its mean inception 0.52 mm from the bifurcation, a mean linear distance of 2.29 mm on the stolon segment, terminating at the next bifurcation; zooid cluster occupying 77–85% of stolon length. Autozooids all tilted distad c. 30–35° from the perpendicular, with a mean length of 0.58 mm in alcohol-preserved retracted specimens, connate; zooid width (as measured in lateral view of zooid cluster) averaging 0.12 mm; owing to the zooid tilt, the distal end of each cluster leans past the point of termination of the zooid insertions at each bifurcation. Outer walls of zooids slightly thicker than interior walls, which are thinnest distally. Polypides and tentacle numbers not observed. Rhizoid originating from a pore at the proximal end of the more proximal stolon segments, each pore occurring just distal to a bifurcation, either laterally on the stolon segment, or on the ‘frontal’ side proximal to the inception of a zooid series, or on the opposite ‘lower’ side of the segment, rarely two rootlet pores per stolon segment, opposite each other on the segment.

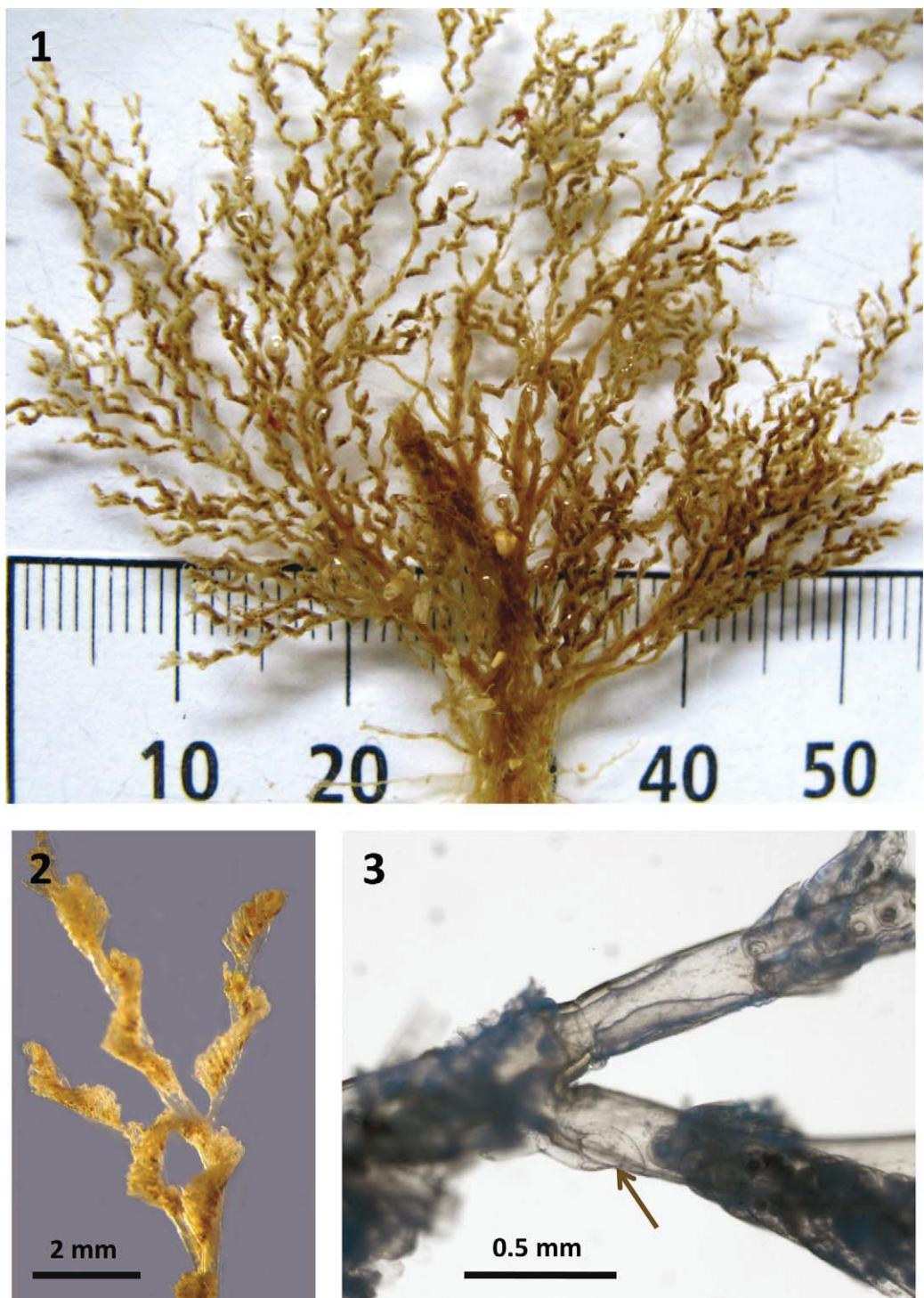
**Remarks.** *Amathia gracei* n. sp. is known only from the type locality and is assumed to be endemic.

*Amathia gracei* n. sp. resembles *Amathia crispa* (Lamarck, 1816), a senior synonym of *Amathia convoluta* Lamouroux, 1816. [Note that, as indicated by d’Hondt (1983), *Serialaria convoluta* Lamarck, 1816 and *Amathia convoluta* Lamouroux, 1816 were independent introductions and do not comprise the same species. Further, the former is a senior synonym of *Amathia spiralis* Lamouroux, 1816. Lamarck’s work was published in March 1816 and Lamouroux’s in October 1816 according to Sherborn (1922, p. lxxvii).] D’Hondt (1983, pl. 3, fig. 1) and Chimonides (1987, fig. 12D) both illustrated *A. crispa*, which differs from *A. gracei* in achieving longer spirals and a longer mean stolon-segment length; also the zigzag angles of the spirals are 60–80° in *A. crispa* but 101–107° in *A. gracei*.

**TABLE 2.** Metrics for the new species of *Amathia* described herein (N = 20 for zooid dimensions; N = 10–20 for other characters).

New species	Zooid length: range, mean, (SD) (mm)	Zooid width: range, mean, (SD) (mm)	Stolon width: range, mean, (SD) (mm)	Stolon length*: range, mean (SD) (mm)	Cluster length: range, mean, (SD) (mm)	Cluster inception: range, mean, (SD) (mm)	% of stolon occupied by zooid cluster	Number of ‘pairs’
<i>chimonidesi</i>	0.52–0.62 0.57 (0.0255)	0.10–0.15 0.13 (0.0117)	0.18–0.30 0.25 (0.0335)	3.54–6.22 4.68 (0.6810)	3.07–4.61 3.67 (0.4433)	0.33–1.53 1.06 (0.3908)	67–96	24–32
<i>gracei</i>	0.47–0.61 0.58 (0.0345)	0.09–0.15 0.12 (0.1150)	0.15–0.30 0.23 (0.0519)	2.58–2.93 2.71 (0.1550)	1.90–2.52 2.29 (0.2205)	0.40–0.67 0.52 (0.0859)	77–85	16–23
<i>similis</i>	0.39–0.56 0.49 (0.0498)	0.10–0.18 0.15 (0.0248)	0.15–0.24 0.20 (0.0234)	2.48–3.47 2.95 (0.3145)	1.01–1.52 1.29 (0.1381)	1.46–2.20 1.65 (0.2322)	36–49	6–14
<i>zealandica</i>	0.46–0.58 0.52 (0.0342)	0.10–0.15 0.13 (0.0123)	0.11–0.24 0.17 (0.0412)	1.62–2.88 2.42 (0.3095)	0.90–1.96 1.62 (0.2813)	0.44–0.77 0.58 (0.1157)	57–75	7–14

\* between branch nodes (single segments only)



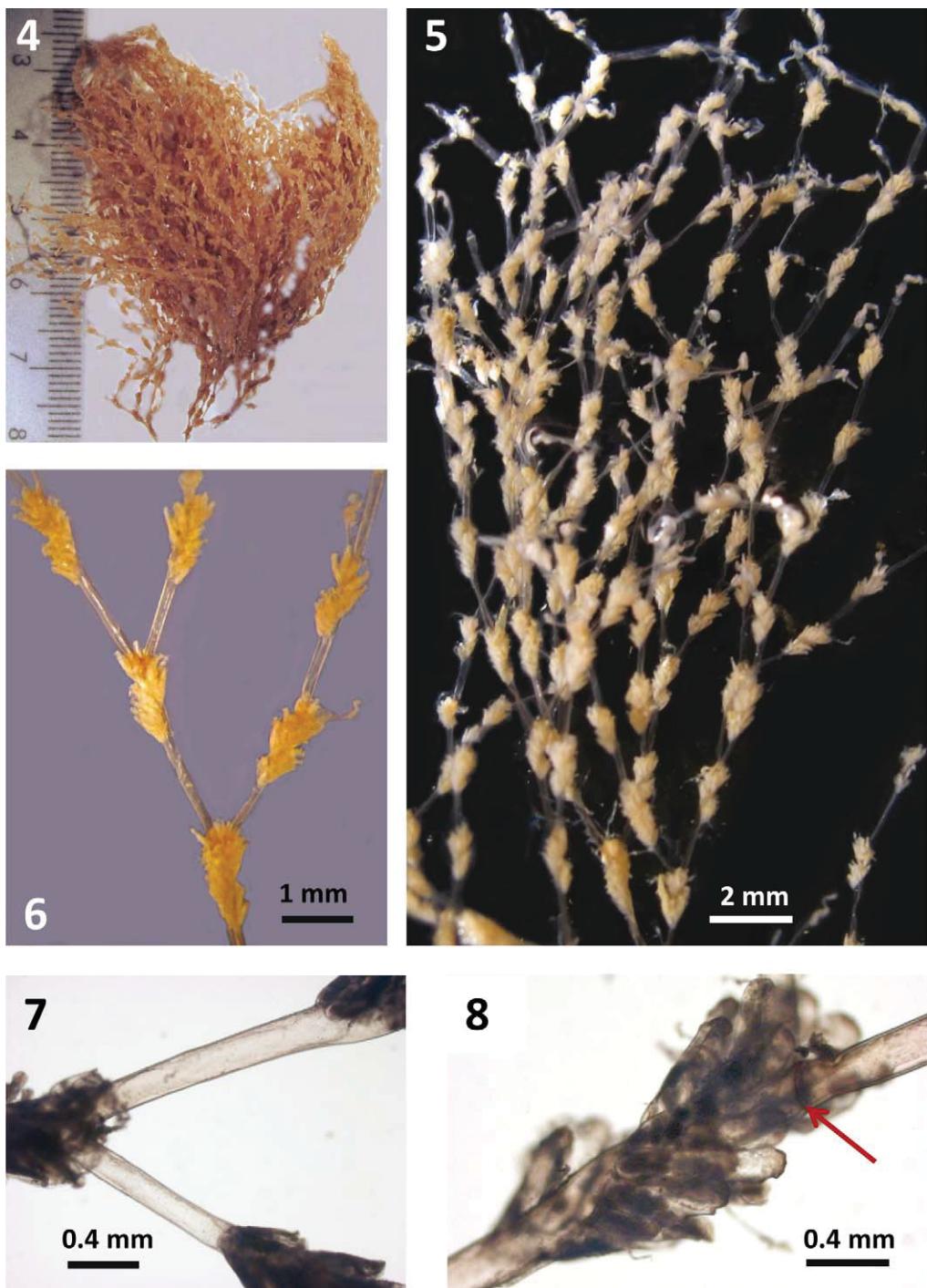
**FIGURES 1–3.** *Amathia gracei* n. sp. 1, holotype colony from ENE of East Cape, North Island; 2, part of colony showing zigzagged clusters of autozooids; 3, branch bifurcation with a rhizoid pore arrowed.

***Amathia similis* n. sp.**

(Figs 4–8, Table 2)

*Amathia biseriata*: Morton & Miller 1968: 411, 413, fig. 152. Non Krauss, 1837.

*Amathia distans*: Gordon, 1967: 48, fig. 5 (figure copied from Prenant & Bobin 1956); Gordon & Mawatari 1992: 11, fig. 2C, pl. 5B; Morton 2004: 272; Gordon et al. 2009: 288. Non Busk, 1886.



**FIGURES 4–8.** *Amathia similis* n. sp. 4, holotype colony from Opua marina, Bay of Islands, North Islands; 5, close-up of branches with tightly spiralled clusters of autozooids; 6, autozooid clusters on stolons; 7, branch bifurcation; 8, autozooid cluster, with position of stolon septum arrowed.

**Material examined.** *Holotype*: NIWA 84931, comprising OPX11163-HY, MITS Cat. # 69732, from the Opua marina, Bay of Islands, New Zealand, 35.3137° S, 174.1223° E, collected 8 September 2010, from a starfish trap deployed overnight at 5 m depth, specimen caught up in trap mesh. *Other material*: MNK208-BR, MITS Cat. #19676, in channel immediately south of Wesley Bay, Manukau Harbour, New Zealand, 36.936° S, 174.7443° E, collected 15 June 2006, c. 6–7 m depth. No paratypes.

**Etymology.** Latin, *similis*, like, resembling, alluding to its similarity with *A. distans*.

**Description.** Colony erect, bushy and densely branching, to 87 mm high, with no anchoring rhizoids, pale brown. Stolon segments straight, mostly 3.0 mm long, mostly terminating at a dichotomy, the angle between the

two branches 40–60°. At each dichotomy, one daughter stolon segment may continue in line with the parent, with the other branching at an angle from the node, but this is not consistent and is often unclear owing to overlap of the node by the distalmost zooids in a cluster. Alternatively, there may be 2–3 stolon segments between dichotomies. Mean stolon width 0.20 mm. Autozooid clusters disposed in tight spirals, each either clockwise or anticlockwise on a stolon segment, comprising c. 6–14 ‘pairs’ per cluster, each cluster describing between one and two complete circuits (360–720°) of the segment from its commencement to its completion (rarely only 320–360°). The spirality of the parent-stolon cluster is maintained in both daughter stolon segments, whether clockwise or anticlockwise. Each cluster has its mean inception 1.65 mm from a bifurcation or stolon septum, a mean linear distance of 1.29 mm on the stolon segment, terminating at the next bifurcation or septum; zooid cluster occupying only 36–49% of stolon-segment length. Autozooids all tilted distad c. 20–45° from the perpendicular, with a mean length of 0.49 mm in alcohol-preserved retracted specimens, connate; zooid width (as measured in lateral view of zooid cluster) averaging 0.15 mm; owing to the zooid tilt, the distal end of each cluster leans past the point of termination of the zooid insertions at each bifurcation. Outer walls of zooids slightly thicker than interior walls, which are thinnest distally. Polypides and tentacle numbers not observed. No rhizoids.

**Remarks.** In New Zealand, colonies of similar form from Waitemata Harbour and shores to the east of the harbour have been attributed to *A. distans* Busk, 1886 [see Gordon & Mawatari (1992) for New Zealand literature summary]. *Amathia similis* shares with *Amathia aegyptiana* d’Hondt, 1983 and *A. distans* a lack of rhizoids but, like *A. aegyptiana* and *Amathia brasiliensis* Busk, 1886, maintains spirality of the autozooid cluster from the parent stolon to both daughter stolon segments; it differs from *A. aegyptiana* in having a much smaller mean stolon diameter and consistently fewer autozooid pairs (see key). *Amathia similis* differs, *inter alia*, from *A. distans* in maintaining the direction of spirality in mother and daughter branches and in having a greater stolon diameter (comparative dimensions non-overlapping—cf. Fehlauer-Ale *et al.* 2011). In autozooid and stolon dimensions, *A. similis* is similar to *A. brasiliensis*, but differs from it in having a smaller occupancy of the autozooid cluster on the stolon segments (only 36–49% compared to 57–72%) and no rhizoids.

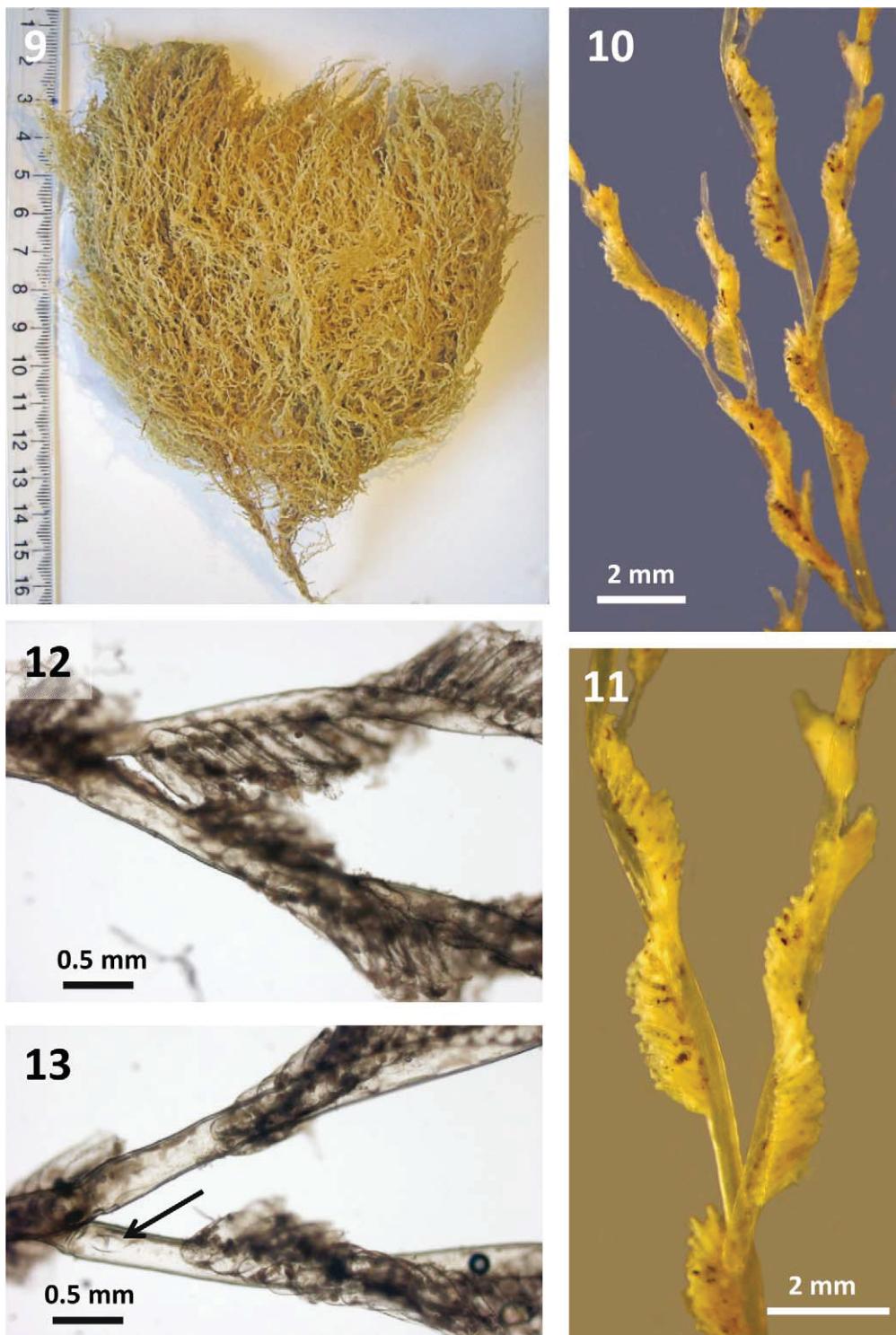
It is unlikely that *A. similis* n. sp. is native to New Zealand, having been found only at or adjacent to ports frequented by merchant and recreational vessels. D’Hondt (1983) and Fehlauer-Ale *et al.* (2011) have noted measurable variation in specimens attributed to *A. distans* in museum collections and in the literature, indicative of unrecognised species, with *A. similis* possibly among them. MacGillivray (1895) described putative *A. distans* from South Australia and Harmer (1915) likewise from Indonesia. Both authors described or illustrated autozooid clusters as occupying 50% of the stolon segments with anticlockwise spirality on both parent and daughter stolons (which rules out genuine *A. distans*, first described from the state of Bahia, Brazil); on the other hand, MacGillivray depicted approximately 13–17 autozooids per cluster compared to 8–12 in Harmer so it is unclear if their material is conspecific. MacGillivray’s scale (not on the same plate as his illustration) seems inconsistent with his magnified figure so the dimensions are uncertain. Harmer (1915) gives some dimensions in his text and a scalebar for his drawings—thus autozooid length is 0.45–0.50 mm and the width is 0.10–0.14 mm; stolon-segment length is 1.6 mm and width 0.10 mm. The stolon dimensions indicate that Harmer’s material is also not conspecific with either *A. brasiliensis* or *A. similis* n. sp. New collecting of fresh material from the published localities, accompanied by gene sequencing, would clarify the status of these various morphologies.

### *Amathia chimonidesi* n. sp.

(Figs 9–13, Table 2)

**Material examined.** *Holotype*: NIWA 84928, comprising AKL11046-HY, MITS Cat. # 69772, from western Waitemata Harbour, east of Soldiers Bay, Auckland, 36.8151°S, 174.6815°E, collected 22 December 2010, from a benthic sled, 5 m depth on mud. *Paratype*: NIWA 84929, from North Head, Waitemata Harbour, Auckland, fresh beach-cast material, collected by Dr Roger V. Grace, 11 April 2003. *Other material*: NIWA 84930, from North Head, Auckland, beach-cast material collected by D.P. Gordon and K.J. Tilbrook, 12 September 2004.

**Etymology.** Honorific for Pantelakis J. Chimonides, Natural History Museum, London, who made a significant contribution to resolving the systematics of non-spiralled *Amathia*.



**FIGURES 9–13.** *Amathia chimonidesi* n. sp. 9, holotype colony from western Waitemata Harbour, Auckland; 10, close-up of branches with long open spirals of autozooids; 11, same, magnified; 12, 13, branch bifurcations, with a rhizoid pore arrowed in 13.

**Description.** Colony erect, very bushy and densely branching to 168 mm high, with a stout tuft of anchoring rhizoids proximally, individual branches pale brown (viewed on white background) to brown (entire colony). Stolon segments almost straight between nodes (the shorter ones), or very gently curving or even sinuous, averaging 4.7 mm long, each terminating at a regular dichotomy, the angle between the two branches 20–80°. At each dichotomy, one daughter stolon continues in line with the parent stolon, with the parent stolon frequently slightly wider than the daughter. Mean stolon diameter (width) 0.25 mm. Autozooid clusters disposed in a

clockwise spiral on each stolon segment, comprising 24–32 ‘pairs’, each cluster describing a complete 360° circuit of the stolon segment from its commencement to its completion; mean inception of each cluster 1.06 mm from the bifurcation, a mean linear distance of 3.67 mm on the stolon segment, terminating at the next bifurcation; zooid cluster occupying 67–96% of stolon length between branch nodes. Autozooids tilted distad c. 20–50° from the perpendicular, with a mean length of 0.57 mm in alcohol-preserved retracted specimens, connate; zooid width (as measured in lateral view of zooid cluster) averaging 0.13 mm; owing to the zooid tilt, the distal end of each cluster leans past the point of termination of the zooid insertions at each bifurcation. Outer walls of zooids slightly thicker than interior walls, which are thinnest distally. Polypides and tentacle numbers not observed. Rhizoid originating from a pore at the proximal end of the more proximal stolon segments, each pore occurring just distal to a bifurcation in a ‘laterofrontal’ position, often two rhizoid pores per stolon segment in more proximal parts of the colony.

**Remarks.** *Amathia chimonidesi* n. sp. is most similar in the sum of its characters to *A. gracei* n. sp., differing from it most obviously in the maximum number of autozooid ‘pairs’ (32 instead of 23–24) and direction of spirality of autozooid clusters throughout the colony (clockwise instead of anticlockwise). [Note, however, that spirality can vary within a species and a colony and only a single specimen of *A. gracei* was available for determining characters.] Also the spirals in *A. gracei* are more ‘angular’ compared to the sinuous spirals in *A. chimonidesi*.

*Amathia chimonidesi* n. sp. resembles published illustrations of *Amathia semiconvoluta* Lamouroux, 1824 from the Adriatic (Heller 1867), the western Mediterranean (Prenant & Bobin 1956) and Atlantic coast of the Iberian Peninsula (Souto *et al.* 2010). However, Prenant & Bobin (1956, in key on p. 279 but not in text) noted that there may be 2–6 stolon segments between dichotomies and Souto *et al.* (2010) confirmed up to three. The autozooid clusters on these segments may be separated only by short gaps, giving the impression of a single very long cluster between dichotomies. This is not the case in *A. chimonidesi*.

The figures in Prenant & Bobin (1956), reproduced from three earlier authors, also show both clockwise and anticlockwise spirals, and Chimonides (1987, figs 5A, 13C, respectively) shows anticlockwise and clockwise spirals, with quite a large gap on the stolon proximally before the spirals begin, raising the question of conspecificity of all the illustrated material, although Souto *et al.* (2010) noted that individual colonies may be either wholly clockwise or anticlockwise. Both of two large colonies of *A. chimonidesi* from Auckland have consistently clockwise spirals. Dr Javier Souto (Universidade de Santiago de Compostela, Spain) was sent photographs and a description of *A. chimonidesi* and he concludes that it is not conspecific with *A. semiconvoluta*. Mean and maximum stolon lengths (i.e. between branch nodes) are respectively 23–43% and 22–46% greater in *A. chimonidesi* and mean and maximum cluster lengths 33–40% and 36–46% greater in *A. chimonidesi* than in *A. semiconvoluta*, based on Souto *et al.*’s (2010) data for lectotype and northwestern Iberian material.

The only known occurrences of this species are as large colonies—one from western Waitemata Harbour, and beach-cast material at the south end of Narrow Neck beach adjacent to North Head, Waitemata Harbour, Auckland. Samples of the latter, evidently originating from the sublittoral zone, were collected on 11 April 2003 (R.V. Grace) and 11 September 2004 (D.P. Gordon and K.J. Tilbrook). There was so much cast ashore at times, in extensive thick drifts, that local residents were complaining in a community newspaper about “the continual row of decomposing material along the high tide mark after storms or easterlies” and the “flies resulting from the debris” that was mistaken for a hydroid (Anon. 2005).

It is almost certain that *A. chimonidesi* n. sp. represents a previously unrecognised alien species with an unknown native distribution, especially since it had never been reported in New Zealand before its discovery in a major shipping harbour just under a decade ago.

### *Amathia biseriata* Krauss, 1837

(Figs 14–18)

*Amathia biseriata* Krauss, 1837: 23, fig. 1a-c; Waters 1887a: pl. 6, fig. 25; Waters 1887b: 264; MacGillivray 1895: 137, pl. B, fig. 4; Macken 1956: 19, figs 1–2; Chimonides 1987: 330, figs 4B, 11C,D (cum syn.).

*Beania swainsoni* Hutton, 1873: 91; Hutton 1880: 185; Jelly 1889: 17.

*Amathia inarmata* MacGillivray, 1887: 183; MacGillivray 1889: 309, p. 185, figs 4, 4a; d’Hondt 1983: 67, fig. 36G.

*Amathia swainsoni*: Hutton 1891: 107; Hamilton 1898: 194, 197; Hutton 1904: 294.



**FIGURES 14–18.** *Amathia biseriata* Krauss, 1837. 14, slide of a specimen from New Zealand in the collection of the Natural History Museum, London; 15, close-up of same showing straight clusters of autozooids on the stolon segments; 16, same, showing the frontal distal curvature of stolon segments; 17, specimen A.88.95 labelled *Beania swainsoni*, Otago Museum, Dunedin. 18, close-up of autozooids showing semicircular, distal cuticularised thickening of rims in the lectotype (NMNZ Pz. 14) of *A. swainsoni* in the Museum of New Zealand Te Papa Tongarewa.

**Material examined.** Museum of New Zealand Te Papa Tongarewa: NMNZ Pz. 14, holotype (so designated by Macken 1956, but actually lectotype) of *Beania swainsoni*, no locality data but presumably from Cook Strait (fide Hamilton 1898); rehydrated from the dried state using aqueous trisodium phosphate, and now preserved in 70% ethanol. Otago Museum: A.88.95, dried card-mounted Hutton specimen labelled “*Beania swainsoni*”, no locality data but presumably from Dunedin area (fide Hamilton 1898). Otago Museum: A.88.96, two small dried colony

fragments labelled “*Beania swainsoni*” in a welled cardboard slide, no locality data but presumably from Dunedin area (fide Hamilton 1898). Natural History Museum, London: NHMUK 1899.7.1.4319, Busk Collection, New Zealand, labelled “*Amathia biseriata*,” 1899.7.1.4401, Busk Collection, ?New Zealand, labelled “*Amathia inarmata*,” and 1899.7.1.4400, Busk Collection, ?New Zealand, labelled “*Amathia unilateralis*” (a species of Lamouroux 1816).

**Description [of *A. swainsoni* lectotype].** Colony portion branching, 58 mm high, with a stout tuft of rhizoids constituting the proximal half, brown. Stolon segments straight or very gently arching convexly on the lower side, averaging 2.3 mm long (range 2.04–2.69 mm), each generally terminating at a dichotomy, the angle between the two branches generally 30–45°. Mean stolon width 0.279 mm (range 0.235–0.314 mm). Autozooid clusters disposed in straight rows on the stolons, but, along the principal stolon axis, successive daughter clusters orientated a little more obliquely (ca. 22%) than the preceding one, such that every fourth cluster is more or less at right angles to the original. Where branching takes place, the daughter stolon segment tending to be a little narrower proximally than the opposing primary stolon, branching at an angle of 20–45°. Autozooids number 6–11 pairs in each cluster, clusters having their mean inception 0.443 mm (range 0.302–0.818 mm) from the joint, a mean linear distance of 1.77 mm (range 1.41–2.11 mm) on the stolon, the bases of the distalmost autozooids terminating just short of the next bifurcation; distal tip of stolon segment frequently curving frontally and often connate with the distalmost autozooid; zooid cluster occupying 60–94% (mean 79%) of stolon length. Autozooids all tilted distad, the proximalmost ca. 45° from the perpendicular, the distalmost 20–45°, with a mean length of 0.453 mm (range 0.390–0.470 mm) in alcohol-preserved retracted specimens, connate, each with a conspicuous semicircle of cuticular thickening of the outer rim, the line of thickening at the same level in each zooid, forming a continuous band when the cluster is viewed from the side; zooid width averaging 0.125 mm (range 0.095–0.140 mm). Polypides and tentacle numbers not observed. Rhizoids originating from pores at the proximal end of the more proximal stolon segments, each pore occurring laterally in the segment relative to the dichotomy and the daughter cluster.

**Remarks.** If one uses Chimonides’ (1987) key to the non-spiralled species of *Amathia*, Hutton’s species keys out to *A. biseriata*. Indeed, Macken (1956) concluded as much based on her examination of Hutton’s material (which she designated holotype) in the then Dominion Museum, comparing it with MacGillivray’s (1895) description and figures. The published illustrations of Krauss (1837) and MacGillivray (1889, 1895) accentuate the convex curvature of the abfrontal side of the stolon segments bearing the autozooids, especially distally in the case of Krauss (1837, fig. 1c) and the short autozooid-free portion of each stolon. In Hutton’s limited material, stolon segments are mostly more or less straight or with gentle curvature, with an upturned distal end. Chimonides (1987, fig. 4B) schematically depicts the stolon segments as mostly straight with only a distal curvature, bending around the distal end of the autozooid cluster; as he also described, this is not the case in every stolon segment and MacGillivray (1895) likewise remarked that the “amount of curvature of the internodes varies, some being almost straight.” Hutton’s material greatly resembles the proximal parts of the colony illustrated in Chimonides’ (1987) figure 11C and the inception of the rhizoid in his figure 11D. In the event, perhaps the most striking characteristic of *A. biseriata*, at least among the New Zealand species of *Amathia*, is the conspicuous dark band of strong cuticularisation of the distal rim of each autozooid in the cluster. MacGillivray (1889, pl. 185, fig. 4a) depicts the cuticularisation as a ring, which may be a misinterpretation; certainly in Hutton’s material it is semicircular, in the proximolateral side of each zooid rim.

There are some metric differences between Hutton’s material of *A. swainsoni* in the Museum of New Zealand Te Papa Tongarewa and the figures given by Chimonides (1987) for *A. biseriata* (presumably based on the neotype from Port Phillip Bay, Victoria). Mean stolon diameter is 0.32 mm in the latter but only 0.279 mm in the former (range 0.235–0.314 mm); mean stolon length between branch nodes is 2.05 mm in the latter but 2.277 (range 2.038–2.688 mm) in the former. Mean autozooid length is only 0.35 mm according to Chimonides, whereas in Hutton’s material it ranges from 0.390–0.470 mm with a mean of 0.453 mm. Metrics for all other characters are very similar or overlap.

Chimonides’ (1987) attribution of *A. biseriata* to the New Zealand fauna is based on only one certain record from New Zealand (NHMUK: registered number 1899.7.1.4319) without precise locality details. Hutton’s (1873) material, “from the collection of the late W. Swainson, Esq.,” has no accompanying locality data either and none of his publications shed any light on the subject. In the 1880s, Augustus Hamilton collected bryozoans from a number of localities in New Zealand and sent them to Miss E.C. Jelly in Bristol, England, who forwarded them to experts

for identification so it seems likely that she herself did not identify them although, against entry 116, *Beania swainsoni*, in her synonymic catalogue, it states “is a species of *Amathia*”. Hamilton’s (1898) tabulated list has two entries for Hutton’s species, one as “*Beania (Amathia ?) swainsoni*” from Dunedin (p. 194) and a second as “*Amathia swainsoni*” from Wellington and Dunedin (p. 197). According to his introductory explanation (p. 192), bryozoan specimens from Wellington were “collected at various times on the shores of Cook Strait” and those from Dunedin were “littoral species collected at various times”. NHMUK specimen 1899.7.1.4319 was thus likely sent by Hamilton. [Jelly specimens now reside in NHMUK.] There are no 20<sup>th</sup> or 21<sup>st</sup> century records or collections of the species from New Zealand and it remains unclear if the earlier records were based on short-lived alien incursions or self-introductions.

***Amathia zealandica* n. sp.**

(Figs 19–21, Table 2)

**Material examined.** *Holotype*: NIWA 84925, from NIWA Stn Z9676, 34.364° S, 172.841° E, NE of Spirits Bay, North Island, 57 m, 25 January 1999. *Paratype*: NIWA 84926, from NIWA Stn Z9677, 34.319° S, 172.825° E, 55 m, NE of Spirits Bay, North Island, 25 January 1999. *Other material*: NIWA 84927, from NIWA R.V. *Tangaroa* cruise 1108, Stn 213 (37.546° S, 178.896° E, east of East Cape, North Island, 68–70 m, 30 May 2011); also NIWA 75476, TAN1108/233 (37.601° S, 178.894° E, east of East Cape, North Island, 50–60 m, 31 May 2011), and NIWA 75503, TAN1108/239 (37.595° S, 178.865° E, east of East Cape, North Island, 56–58 m, 1 June 2011).

**Etymology.** The name reflects the species’ status as a New Zealand endemic.

**Description.** Colony erect, bushy and densely branching, to 66 mm high, with a stout tuft of anchoring rhizoids proximally, pale brown. Stolon segments straight or very gently arching concavely or convexly on the lower side, the shortest ones showing slightly more convexity; averaging 2.4 mm long, each terminating at a regular dichotomy, the angle between the two branches generally 40–45°, although angles of 60° and 80° have been encountered. Mean stolon width 0.17 mm. Autozooid clusters disposed in straight rows on the stolons, those on one daughter stolon having nearly the same orientation as the parent stolon, those on the other inclined at an angle of c. 25–45° from the perpendicular towards the adjacent cluster; comprising 7–14 ‘pairs’ per cluster. Each cluster has its mean inception 0.58 mm from the bifurcation, a mean linear distance of 1.62 mm on the stolon and terminates at the next bifurcation; distal tip of stolon segment frequently curving frontally and connate with the distalmost autozooid; zooid cluster occupying c. 57–75% of stolon length. Autozooids all tilted distad, the proximalmost ca. 10–15° from the perpendicular, the distalmost c. 45°, with a mean length of 0.52 mm in alcohol-preserved retracted specimens, connate, with outer walls slightly thicker than interior walls; zooid width (as measured in lateral view of zooid cluster) averaging 0.13 mm. Polypides and tentacle numbers not observed. Rootlets originating from pores at the proximal end of the more proximal stolon segments, each pore occurring on the opposite ‘lower’ side of the segment.

**Remarks.** As with Hutton’s (1873) type specimen of *A. swainsoni*, the present material also keys out to *A. biseriata* Chimonides’ (1987) key, but there are a number of differences. The most distinctive feature of *A. biseriata* is the conspicuous semicircular cuticularised thickening of the autozooidal rim and this is completely lacking in *A. zealandica* n. sp., which is also less robust (especially the autozooids) and paler in appearance when samples of the two species are seen side by side in the same microscope field. Likewise there is no marked curvature of the abfrontal surface of the stolon segments as seen in profile compared to typical Australian material of *A. biseriata*. The first and obvious impression on viewing a colony of *A. zealandica* is of long narrow zooid clusters on straight stolon segments. Chimonides (1987) made a distinction between daughter stolons produced linearly and laterally from the parent stolon but there is no consistent distinction in *A. zealandica*. In cases where there is distal curvature of the stolon, one daughter stolon continues beyond the septum behind the distalmost zooid while the other stolon is produced from a septum that is generally ‘below’ (in a topological sense) the distalmost zooid; nevertheless, the net result is that the daughter zooid cluster distal to any curvature has nearly more or less the same orientation as the parent-stolon cluster and the other is somewhat inclined towards it.

There are other differences, mostly metric, summarised in Table 3 below.

Chimonides (1987) did not give ranges for his metric data. From the above tabulation, *A. zealandica* n. sp. has longer and thinner stolon segments (internodes) and longer zooids, on average, than Australian *A. biseriata*. The

orientation of autozooids in the clusters also differs; all are inclined distad, but, whereas the proximal zooids of *A. biseriata* are generally inclined at an angle of 45° from the perpendicular, those of *A. zealandica* are more upright, inclining only 10–15°.

*Amathia zealandica* n. sp. is known only from the far north and east of North Island, New Zealand, at depths of 50–60 m.



**FIGURES 19–23.** *Amathia zealandica* n. sp. 19, colony from NIWA Stn TAN1108/213, E of East Cape, North Island; 20, close-up of same showing straight clusters of autozooids on the stolon segments; 21, same, branch bifurcations and autozooidal clusters. 22, 23, *Amathia bicornis* (Tenison-Woods, 1877) from Makara Beach, west coast, Wellington region, North Island, showing autozooidal spirals with cuticularisation of autozooids and distal 'horns'.

TABLE 3. Metric differences between *Amathia zealandica* n. sp. and *A. biseriata* Krauss.

Material	Mean stolon length (mm)	Mean stolon width (mm)	Mean zooid length (mm)	Mean zooid width (mm)	% of stolon occupied by zooid cluster	No. of zooid 'pairs'
<i>A. biseriata</i> <sup>1</sup>	2.05	0.32	0.35	0.11	75	4–12
<i>A. biseriata</i> <sup>2</sup>	2.28	0.28	0.45	0.13	60–94	8–10
<i>A. zealandica</i> n. sp.	2.42	0.17	0.52	0.12	57–75	7–14

1—Australian data from Chimonides (1987); 2—New Zealand data based on measurements of Hutton's type of *A. swainsoni* (= *A. biseriata*)

### *Amathia lamourouxi* Chimonides, 1987

*Amathia lamourouxi* Chimonides, 1987: 322, figs 3A, 8C, 9A,C (cum syn.).

**Material examined.** BMNH; 1899.7.1.3, 'New Zealand', no other locality data.

**Remarks.** Chimonides (1987) established this species as a nomen novum for *Amathia cornuta* Lamouroux, 1816 (and of authors), preoccupied by *Amathia cornuta* (Lamarck, 1816), a different species. He established a neotype, based on a specimen from Port Phillip, Victoria; most other material in NHMUK came from southeastern Australia, including also Bass Strait and Sydney. The sole specimen said to have been collected in New Zealand is the only known such record; no specimens of *A. lamourouxi* have been found in the collections at NIWA or the Museum of New Zealand Te Papa Tongarewa.

The species is arborescent and supported by rhizoids, and terminal stolon segments that bear no autozooids are produced at the distal end of each autozooid cluster. Clusters comprise 11–15 autozooids, more or less in 5–7 pairs that are not spiralled on the stolon segments (see the key to the New Zealand amathiid species, below).

Chimonides (1987) pointed out the obvious similarities of this species with *Amathia australis* (Tenison-Woods, 1878). The only apparent difference is that *A. australis* is depicted as having both dichotomous and trichotomous branching, whereas all specimens examined by Chimonides are dichotomous. The whereabouts of Tenison-Woods' material is not known. If the characters of *A. australis* can be established with certainty, especially as regards branching, and demonstrated to be identical to *A. lamourouxi*, the earlier name would have priority.

### *Amathia bicornis* (Tenison-Woods, 1880)

(Figs 22, 23)

*Serialaria spiralis* Tenison-Woods, 1878: 84, pl. 2. Non *Amathia spiralis* Lamouroux, 1816.

*Amathia bicornis* Tenison-Woods, 1880: 102; MacGillivray 1887: 221; MacGillivray 1889: 307, pl. 185, figs 1, 1a, 1b; MacGillivray 1895: 132, pl. A, fig. 2.

*Amathia acervata*: d'Hondt 1979: 10, 16; d'Hondt 1983: 65, fig. 36E; d'Hondt 1991: 163, 165; Gordon *et al.* 2009: 288. Non *Amathia acervata* Lamouroux, 1824.

**Material examined.** NIWA 84932, a dried beach-cast specimen attached to a stranded seaweed, *Carpophyllum maschalocarpum* (Sargassaceae), Makara, Wellington Region west coast, February 1983, collected by D.P. Gordon; specimen since reconstituted in trisodium phosphate and preserved in ethanol.

**Description.** Colony erect, bushy and densely branching, compact, to 35 mm high and wide, with a tuft of anchoring rhizoids proximally, brown. Stolon segments more or less straight but with an obvious sinuosity within the spiral autozooid cluster, the segments single or double between bifurcations; averaging 2.9 mm long (range 2.8–3.1 mm), each terminating at a regular dichotomy, the angle between the two branches generally 40–70°. Mean stolon width 0.148 mm (range 0.123–0.168 mm; SD 0.013 mm). Autozooid clusters disposed in tight spirals, each describing 1.25–1.5 turns around the internodal stolon segment, clockwise or anticlockwise along individual branches, comprising 16–19 'pairs' per cluster. Each cluster has its mean inception 1.46 mm (range 1.19–1.86 mm)

from the bifurcation or from a septum, a mean linear distance of 1.48 mm (range 1.23–1.76 mm) on the stolon and terminates at the next bifurcation or septum, with the autozooid tips projecting beyond it; zooid cluster occupying c. 41–59% (mean 50%) of stolon length. Autozooids all with paired hornlike processes, each an extension of the cuticularised outer distal corner, with a mean length (not including ‘horns’) of 0.539 mm (range 0.498–0.582 mm), connate for their entire length except for the ‘horns’, with abutting edges of connate walls more obviously cuticularised than interior walls; zooid width averaging 0.151 mm (range 0.146–0.168 mm). A rhizoid originating from a pore at the proximal end of the more proximal stolon segments, the pore occurring on the ‘side’ of the segment, passing down the collective stolon axis on the inside of the autozooidal spirals.

**Remarks.** According to d’Hondt (1979, 1983, 1991), *A. bicornis* Tenison-Woods, 1880, is a junior subjective synonym of *Amathia acervata* Lamouroux, 1824, but this synonymy is puzzling, since the original descriptions and stated provenances (Japan and southeastern Australia) of these species do not conform. Recent correspondence (30 June 2012) from Dr Jean-Loup d’Hondt has confirmed that this synonymy was based on a misunderstanding.

The occurrence of *A. bicornis* on an endemic New Zealand seaweed at a west coast locality not close to a port or a harbour appears to be natural, so the species is either a relatively recent self-introduction or it has long been present but overlooked.

#### *Amathia wilsoni* Kirkpatrick, 1888

(Figs 24, 25)

*Amathia wilsoni* Kirkpatrick, 1888: 18, pl. 2, figs 4, 4a; MacGillivray 1895: 139, pl. D, figs 2, 2a, 2b; Jelly 1889: 14; Macken 1956: 22, fig. 4; d’Hondt 1983: 67, fig. 36A; Chimonides 1987: 327, figs 4D, 10C, D; Gordon 1986: 17, fig. 4A,B; Gordon *et al.* 2009: 288.

**Material examined.** Museum of New Zealand Te Papa Tongarewa: NMNZ ZPz. 80, Karaka Bay, Wellington, August 1930. NIWA: Unregistered material from Stn B493, 45°34.4' S, 166°39.1' E, Breaksea Sound, Fiordland, 84 m, 8 June 1961; Stn Z9689, 34.324° S, 172.826° E, north of Spirits Bay, Northland, 63 m, 27 January 1999; Stn Z9702, 34.316° S, 172.793° E, north of Spirits Bay, Northland, 68 m, 28 January 1999. Natural History Museum, London: NHMUK 99.7.1.4345, 4348, 4348b (labelled “*Amathia delicatissima*”), Busk Collection, Lyall Bay, Cook Strait, New Zealand (collected by Dr David Lyall, of H.M.S. *Acheron*, which did survey work in 1847).

**Remarks.** Gordon (1986) noted that this is the commonest and most widespread of the known *Amathia* species in New Zealand, ranging from The Three Kings Islands to Fiordland and that large quantities are often washed ashore on Wellington south coast beaches after southerly storms. Its delicate, creamy-whitish-transparent, fluffy appearance underwater and distinctive branch tri- and tetrachotomies make this species instantly recognisable.

#### Genus *Bowerbankia* Farre, 1837

##### *Bowerbankia citrina* (Hincks, 1877) *sensu lato*

(Figs 26, 27)

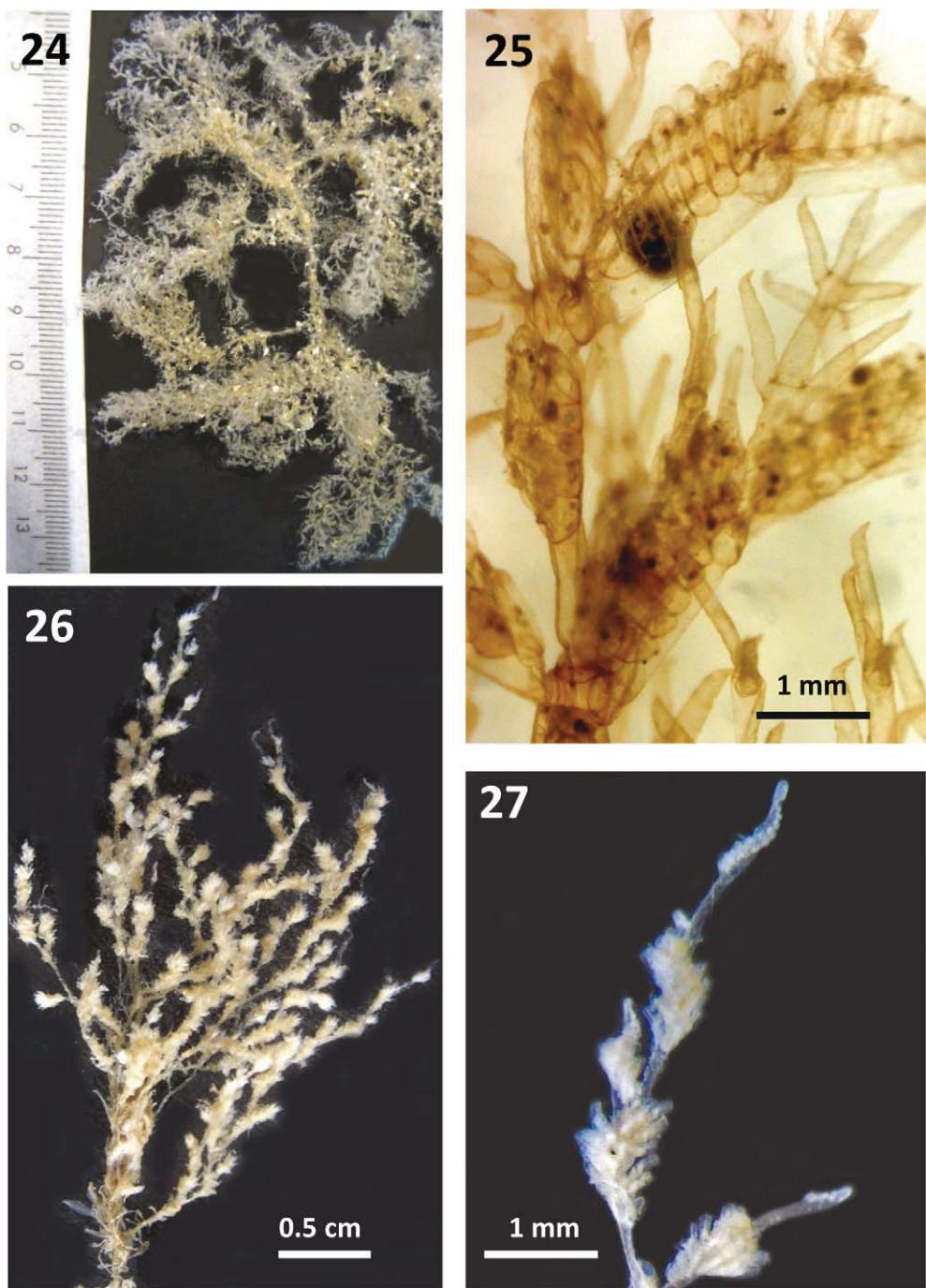
*Valkeria citrina* Hincks, 1877: 215.

*Bowerbankia citrina*: Hincks 1880: 524, pl. 76, figs 6–8; Prenant & Bobin 1956: 300, figs 122(7), 135, 136(1–3); d’Hondt 1983: 61, fig. 32E; Hayward 1985: 142, fig. 48; De Blauwe 2009: 86, figs 66–68; Souto *et al.* 2011: 2549, figs 5, 6, 7b.

**Material examined.** NIWA 84933, low tide under rocks, north-central Porirua Harbour under the penultimate boatshed along Onepoto Road, collected by D.P. Gordon, 7 February 2012.

**Description.** Colony with straggling erect branches attached by rhizoids, to about 5 cm high. Stolon segments more or less straight to slightly bent, averaging 1.95 mm long (range 1.86–2.07 mm), each producing a daughter branch at an angle of 30–70°. Mean stolon width 0.144 mm (range 0.123–0.190 mm). Autozooid clusters disposed in loose, more-or-less anticlockwise half-spirals at the distal ends of stolon segments, with about 18–24 autozooids in each cluster. Each cluster has its mean inception about 0.79–0.86 mm from a bifurcation, a mean linear distance of 1.42 mm (range 1.23–1.68 mm) on the stolon and terminates at the next bifurcation, with the autozooid tips

projecting beyond it. Autozooids transparent, with a mean length of 0.522 mm (range 0.437–0.616 mm), their orifices somewhat squared when retracted; zooid width averaging 0.142 mm (range 0.112–0.168 mm), tentacles 8, each with a distinctive line of yellow pigment running the full length.



**FIGURES 24–27.** *Amathia wilsoni* Kirkpatrick, 1888. 24, general appearance of colony, from NIWA Stn Z9689, 34.324° S, 172.826° E, 63 m depth, Three Kings Islands, North Island; 25, close-up of specimen 99.7.4345 (on slide), Busk Collection, Natural History Museum, London, from Lyall Bay, Wellington, showing disposition of autozooidal clusters and terminal kenozooidal stolon segments. 26, 27, *Bowerbankia citrina* (Hincks, 1877) sensu lato, from Porirua Harbour, North Island.

**Remarks.** This is the first record of an ‘amathiaiform’ *Bowerbankia* from New Zealand. Its most distinctive feature when viewed alive by light microscopy is the strong lemon-yellow colour that resides in the tentacles of the polypide, exactly as shown in the photographs of De Blauwe (2009) and Souto *et al.* (2011). The colour is not seen in preserved material. A specimen was sent to the laboratory of Dr Karin Hoch Fehlauer-Ale at CEBIMar-USP (Brazil) for DNA sequencing, to be compared with *B. citrina* from Wales and Spain. Based on preliminary

phylogenetic analyses of the mitochondrial genes, large ribosomal RNA subunit (16S) and cytochrome *c* oxidase subunit 1 (COI), Dr Fehlauer-Ale suggests: “the specimen from New Zealand probably represents a new species of *Bowerbankia*, sister to the European clade of *B. citrina*” and “it seems we might have a complex of cryptic species under the name *B. citrina*.”

Waeschenbach *et al.* (2012) noted that an unnamed species of *Amathia* nested within the cluster of *Bowerbankia* species that they sequenced on the basis of two nuclear ribosomal and five mitochondrial genes (including 16S rRNA and COI), with *B. citrina* as sister to the *Amathia* in the distalmost part of the tree. Since *Amathia* was the first-named genus, it suggests that the genus *Bowerbankia* may be subsumed in *Amathia* but, as the authors noted, taxon sampling is needed, which would clarify the relationships among the morphological extremes in both genera. Even though autozooids are disposed in spirals on the distal half of each stolon segment in *Bowerbankia pustulosa* (Ellis & Solander, 1786) and *B. citrina*, these species differ quite obviously from *Amathia* because of the loose, non-connate nature of the autozooids, which also lack any differential cuticularisation of the body wall. The genetic data imply that these characters evolved more than once in *Amathia*, in which seriation of autozooids in the clusters, in actual or slightly offset pairs, is such a striking feature.

New Zealand *B. citrina* sensu lato was first noted in Porirua Harbour in March 2011. Rather less of it was found in 2012, at the same locality, but the species has the potential to spread within New Zealand. The Porirua Harbour specimens were somewhat fouled by epizoic diatoms, tiny red algae and two other ctenostome bryozoans when collected in 2012; in New Zealand the latter ctenostome species are conventionally referred to as *Bowerbankia gracilis* Leidy, 1855 and *Buskia nitens* Alder, 1857 (but detailed morphological comparisons and gene sequencing of topotypic material are necessary to establish their identity with certainty).

#### **A note on the purported record of *Amathia lendigera* in New Zealand**

Macken (1956) examined a specimen of *A. lendigera* in the collection of the Museum of New Zealand Te Papa Tongarewa (registered as Pz. 79) that was noted to have been collected from Napier by Miss E.M. Williams in 1935. We have examined this specimen (which was in a vial and dried but is now preserved in 70% ethanol after having been reconstituted in aqueous trisodium phosphate). It is certainly *A. lendigera*, not either of the *lendigera* look-alikes named by Chimonides (1987), i.e. *A. intermedis* and *A. guernseii*. Overlooked by Macken, however, were tiny colonies of two other bryozoans growing on *A. lendigera*, viz. *Electra pilosa* (Linnaeus, 1767) and *Scrupocellaria scruposa* (Linnaeus, 1758). The only similar spinose electiform species in New Zealand is *Electra scuticifera* Nikulina, 2008 (previously wrongly attributed to *E. pilosa*), whereas that in the sample conforms fully to *E. pilosa*; likewise the only mainland-coast species of *Scrupocellaria* in New Zealand is *S. ornithorhyncus* Thomson, 1858, whereas that in the sample conforms fully to *S. scruposa*.

The co-occurrence of these three species, all of which are well-known in Europe, mitigates strongly against the sample having come from Napier and we suspect that either the purported provenance was based on a misunderstanding or that the specimen was subsequently mislabelled in the Te Papa collection; there are quite a number of bryozoan samples from Britain at Te Papa and it appears likely that the *A. lendigera* should be counted as one of them.

While it is not impossible that the specimen of *A. lendigera* was collected directly from the hull of a ship at the port of Napier in 1935, it seems unlikely that the small, non-reproductive epizoic colonies of the two other species, which appear to have been alive at the time of collection, would have survived the passage from European waters to New Zealand via the tropics. [The species is not known to be naturalised outside of Europe, so neither it, nor indeed its epizoites, can have been picked up through a temporary stoppage at a foreign port while en route to New Zealand.] Our conclusion is that the sole record of *A. lendigera* in New Zealand was based on a misunderstanding or labelling error and does not represent a failed introduction of an alien species.

#### **Discussion**

Based upon his study of fifteen *Amathia* species with no spiralling of autozooids about the stolon (or weakly so owing to a twisting of the stolon segment itself), Chimonides (1987) listed seven diagnostic characters useful for

discrimination, ranking them in order of reliability: 1) budding pattern of stolons; 2) development of any kenozooidal processes or rhizoids and their orientation; 3) arrangement of autozooids about the stolons; 4) autozooidal thickening; 5) profile of autozooids and stolons; 6) number of autozooids and proportion of stolon occupied by autozooids; and 7) dimensions of components. With respect to character 1, he ascertained that the branching pattern remains remarkably consistent within species. Characters 1–3 in combination give rise to characteristic colony shapes that, with familiarisation, allow identification of species by casual inspection. Fehlauer-Ale *et al.* (2011) noted that the expression of rhizoids can be inconstant within some species.

The balance of described *Amathia* taxa includes 12 species in which there is significant ( $>100^\circ$ ) spiralling of zooid clusters about the stolon segments. As with the non-spiralling species, these also constitute a range of colony morphologies with different budding patterns. The differences among these species are expressed in the following key, which also includes *Amathia gracei* n. sp., *Amathia chimonidesi* n. sp. and *Amathia similis* n. sp.

**Key to the spiralled species of *Amathia* and *Amathia*-like *Bowerbankia*\*:**

1. Autozooids not connate, their body wall not differentially thickened (*Bowerbankia*) ..... 2
- Autozooids connate for at least half their length, body wall differentially thickened (*Amathia*) ..... 3
2. Polypide with yellow tentacles; biseriality weakly developed ..... *citrina*
- Polypide with unpigmented tentacles; biseriality moderately developed ..... *pustulosa*
3. Autozooids with conspicuous spine-like processes apically ..... *bicornis*
- Autozooids lacking apical processes ..... 4
4. Autozooid clusters short, never exceeding 9 'pairs' of zooids ..... 5
- Autozooid clusters routinely exceeding 9 'pairs' of zooids ..... 7
5. Typically 4–7 autozooid 'pairs' per cluster ..... 6
- Typically 8–9 autozooid 'pairs' per cluster ..... *vidovici*
6. Number of clusters between dichotomies only 1 ..... *dichotoma*
- Number of clusters between dichotomies up to 3–4 ..... *semispiralis*
7. Maximum stolon diameter in the range of 0.36 to  $<0.4$  mm ..... *connexa*
- Maximum stolon diameter not exceeding 0.3 mm ..... 8
8. Spirals between bifurcations vermetiform (up to 11 turns), zooids prostrate ..... *vermetiformis*
- Spirals and zooids otherwise ..... 9
9. Spirals subhorizontal in lateral view, continuous, sheet-like, concealing branches ..... *convoluta*
- Spirals otherwise ..... 10
10. Occupancy of zooid cluster on stolon consistently  $>90\%$  ..... *crispa*
- Occupancy of zooid cluster on stolon not consistently  $>90\%$  ..... 11
11. Occupancy of zooid cluster on stolon in range of 36–49% ..... *similis* n. sp.
- Occupancy of zooid cluster on stolon exceeding 49% ..... 12
12. Spirality  $<250^\circ$  ..... 13
- Spirality  $\geq 270^\circ$  ..... 14
13. Zooid pairs 15–21, occupancy of cluster on stolon 53–67% ..... *minoricensis*
- Zooid pairs 20–27, occupancy of cluster on stolon 68–73% ..... *tortuosa*
14. Maximum number of zooid pairs per cluster 19 ..... 15
- Maximum number of zooid pairs per cluster  $>19$  ..... 16
15. Stolon diameter 0.09–0.14 mm, yellow-pigmented ..... *distans*
- Stolon diameter 0.22–0.25 mm diameter, no yellow pigment ..... *brasiliensis*
16. Rhizoids absent ..... *aegyptiana*
- Rhizoids present ..... 17
17. Autozooidal spiral proximal to bifurcation  $270$ – $315^\circ$  ..... *semiconvoluta*
- Autozooidal spiral proximal to bifurcation  $360^\circ$  ..... 18
18. Autozooid pairs 24–32, spirality only clockwise ..... *chimonidesi* n. sp.
- Autozooid pairs 16–23, spirality (apparently) only anticlockwise ..... *gracei* n. sp.

\*Not including *A. acervata* from Japan, which has yet to be properly characterised based on fresh material and a rehydrated fragment of the type specimen.

## Key to the species of *Amathia* and ‘amathiiform’ *Bowerbankia* in New Zealand

1.	Autozooids not connate, their body wall not differentially thickened . . . . .	<i>Bowerbankia citrina</i> s.l.
	Autozooids connate for at least half their length, with differential cuticularisation ( <i>Amathia</i> ) . . . . .	2
2.	Autozooid clusters disposed spirally on stolon segments . . . . .	3
	Autozooid clusters not spiralled on stolon segments . . . . .	6
3.	Autozooids with paired distal ‘spines’ . . . . .	<i>bicornis</i>
	Autozooids lacking distal spine-like processes . . . . .	4
4.	Autozooidal clusters occupying < 50% of stolon length . . . . .	<i>similis</i> n. sp.
	Autozooidal clusters occupying more than 50% of stolon length . . . . .	5
5.	Autozooid pairs 24–32, spirality only clockwise . . . . .	<i>chimonidesi</i> n. sp.
	Autozooid pairs 16–23, spirality only anticlockwise . . . . .	<i>gracei</i> n. sp.
6.	Branching trichotomous, branch tips without autozooids, more or less pinnate . . . . .	<i>wilsoni</i>
	Branching dichotomous, branch tips otherwise . . . . .	7
7.	A pair of delicate spine-like processes distal to each autozooidal cluster . . . . .	<i>lamourouxi</i>
	No delicate spine-like processes distal to each autozooidal cluster . . . . .	8
8.	A distinct band of cuticular thickening near outer distal end of each autozooid . . . . .	<i>biseriata</i>
	No such distinct band of cuticular thickening . . . . .	<i>zealandica</i> n. sp.

*Amathia* is a highly distinctive, easily recognisable genus but some of its species have been and continue to be confused and, as indicated in the preceding account, undescribed species have the potential to be shoe-horned into existing species. Gene sequencing holds much promise in providing supplementary molecular characters and should aid in speedier, unequivocal identification in the future, as well as highlighting the existence of undescribed cryptic species. Following from the work of Waeschenbach *et al.* (2012), if it should be found that species of *Amathia* and *Bowerbankia* consistently nest together and that the genera should be merged, *Amathia* Lamouroux, 1812 would take precedence over *Bowerbankia* Farre, 1837.

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